

DISNEY2GO

SOLUTION TO OVERCROWDED THEME PARKS: TECH BASED CROWD MITIGATION TOOL

by

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Master of Digital Media, 2017
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ABSTRACT

The purpose of this project is to investigate the effectiveness of how a mobile app integrating augmented reality and GPS technology can influence crowd behaviour in the themed entertainment industry. In partnership with Dr. Asgary, Associate Professor of Disaster & Emergency Management at York University and a member ADERSIM, the study was conducted on the AnyLogic Simulation system to measure how Disney characters can act as a crowd mitigation tool to influence crowd movements throughout the Magic Kingdom. Using data to represent park entrance rates, attraction duration, and wait times, the study was able to capture the level of influence Disney characters had on park guest's movements throughout their visit. This simulation reveals that Disney characters have the ability to influence crowd behaviour with a probability rate of approximately 30%. This data supports the view that the proposed mobile app will act as an effective crowd mitigation tool and can strategically influence crowd migration throughout the Magic Kingdom.

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Introduction

Disney is continuously searching for ways to remain relevant and unique in a highly competitive themed entertainment industry. With theme and amusement parks around the world introducing new rides and attractions, Disney is turning to the latest technology to separate themselves from the competition. As Disney continues to revitalize and revolutionize the themed entertainment industry, implementing unique technology will change the face of Disney as well as overall guest experience. In addition to staying competitive within the industry and staying current with technology, Disney is also looking at ways to improve the overall experience for their guests, whether it is increased customer satisfaction, crowd mitigation, or improved wait times for attractions throughout the park. The purpose of this project is to investigate the effectiveness of how a proposed mobile app, Disney2Go, integrating augmented reality and GPS technology can use Disney characters as tools to attract and influence crowd behaviour in the themed entertainment industry. Disney2Go will introduce crowd mitigation techniques within the Disney park and also to introduce revolutionary technology to the industry leader. This major research project explores how Disney2Go can provide a solution to overcrowding within the themed entertainment industry. Through a simulation format, the crowd mitigation theory was measured and tested how Disney characters can act as a crowd mitigation tool to influence crowd movements throughout the Magic Kingdom.

Review

Crowd Mitigation

In an industry where safety and positive overall experience are the primary goals for a park's guests, developing effective crowd mitigation techniques are vital. One primary focus for parks and businesses within the themed entertainment industry is crowd mitigation and maintaining crowds at a safe and effective level. Crowding is a significant problem among theme and amusement park guests (Brown, Kappes & Marks, 2013, 426). Walt Disney attractions worldwide attract almost 138,922,000 guests per year at their parks (Themed Entertainment Association [TEA], 2016, 9). More specifically, the Magic Kingdom in Disney World attracted approximately 20,395,000 guests in 2015 (TEA, 2016, 10). As theme parks, particularly Disney World attractions, attract millions of people each year, understanding how crowds operate and behave is significant to developing effective crowd mitigation techniques.

Human crowd movements are significantly driven by self-organized practices as more than seventy percent of movements are done in groups (Moussaïd et al., 2010, 1). Moussaïd et al., (2010) are defining groups as social ties among individuals who are intentionally walking together. These interactions can influence human behaviour in various locations, thus effecting movements and behaviours (Moussaïd et al., 2010, 1). Moreover, pedestrians also have significant impact on overall traffic. For example, U and V-like group walking configurations can alter how groups and surrounding pedestrians move in different environments (Moussaïd et al., 2010, 5). Spatial patterns within and between groups reflect the strength of social interactions among individuals. Moussaïd et al., (2010) note that an increased group size will decrease the overall walking speed of the group (Moussaïd et al., 2010, 4). Behaviours such as spatial patterns and walking speeds are important to note as they help illustrate how crowds operate. In addition,

it allows businesses, particularly in the themed entertainment and amusement park industry, to plan and model infrastructure to accommodate crowds of all shapes and sizes.

Although monitoring movements may seem straight forward, tracking and modeling movements can pose difficulty because of an individual's psychological interdependencies (Kountouriotis, Thomopoulos & Papelis, 2014, 30). Due to the various influential elements within group decision making, tracking and attempting to mimic crowd behaviour is difficult. Furthermore, unique psychological and emotional states of humans cause varying reactions multiple stimuli (Kountouriotis, Thomopoulos & Papelis, 2014, 31). Environmental perception can influence movements and behaviours among pedestrians, especially in a Disney environment where there are continuous stimuli and attractions to observe and participate in.

As crowding is a significant problem among theme and amusement park guests (Brown, Kappes & Marks, 2013, 426), it creates frustration and dissatisfaction for many park guests. It also deters people from coming back to the park or entering the park all together (Brown, Kappes & Marks, 2013, 426). Flexible guest itineraries have mitigated crowding by moving guests to less crowded areas and rides (Brown, Kappes & Marks, 2013, 426). However, more resources need to be developed to further accommodate significant crowd levels. Scholars and various companies, including Disney, have investigated that flexible itineraries are not the only solution to an overcrowding problem and continue to investigate various crowd mitigating techniques to improve guest's overall experience within the park. The themed entertainment industry will continue to improve the overall experience for park guests and create effective crowd mitigation techniques.

There have been various studies and experiments completed by theme and amusement parks to identify how useful incentives and bonuses are in attempt to move crowds throughout

the park. One article in particular recently tested out the success of a mobile device using incentives and bonuses to move crowds. “Mitigating Theme Park Crowding with Incentives and Information on Mobile Devices” by Brown, Kappes and Marks analyzes this theory. The study utilized pushed incentives sent to guests’ mobile devices to move individuals and groups of people to other parts of the park; areas that are particularly less busy or popular (Brown et al., 2013, 427). Throughout the day, participants would receive incentives called “bonuses.” The bonuses ranged from current wait times, preferred seating at a show, discounts on food, beverages, and merchandise (Brown et al., 2013, 428). These bonuses were sent in real time to provide accurate real time observation and information. Bonuses focused on increased visitation to less busy restaurants, rides, and attractions to move crowds to less busy areas (Brown et al., 2013, 429). The study showed that the redemption rates for the bonuses and incentives were high enough that theme parks would be able to mitigate and move crowds effectively, for rides, attractions, restaurants, store, and more, if it were deployed on a wide scale (Brown et al., 2013, 430). These findings are profound as theme parks are able to improve load balancing throughout the park and overall guest satisfaction.

Studies like these will become increasingly more prominent as theme parks investigate new crowd mitigation techniques to improve guest’s overall experience. In addition, as technology is continuously enhancing and making significant progress in today’s society, Disney will continuously look to advance their rides and attractions. By implementing effective crowd mitigation techniques as well as advanced technology, Disney can continue to be a leader in the themed entertainment industry.

Disney Statistics

Walt Disney attractions have become an international sensation. Hundreds of millions of guests visit these attractions each year. According to TEA, the Themed Entertainment Association (2016) and AECOM, the Architecture, Engineering, Construction, Operations, and Management company, Walt Disney attractions were the number one visited groups of attractions in 2016. With an increase of almost three percent, approximately 138,922,000 guests visited Disney attractions in 2016 (TEA, 2016, 9). TEA publishes an annual report of the themed entertainment and amusement park industry called the Theme Index Report which is produced through collaboration between AECOM and TEA. The figures and statistics for theme and amusement parks worldwide are obtained through a variety of sources. The statistics are procured directly by park operators, historical numbers, financial reports, and local tourism organizations (TEA, 2016). While Disney will never release their entrance numbers as it is one of their well kept secrets, TEA and AECOM provides some of the most accurate data within the industry.

Park Name	Attendance Numbers	Percentage Change (from 2015 to 2016)	Overall Ranking (2016)
Magic Kingdom	20,395,000	-0.5%	#1
Disneyland	17,943,000	-1.8%	#2
Epcot	11,712,000	-0.7%	#6
Animal Kingdom	10,844,000	-0.7%	#7
Hollywood Studios	10,776,000	-0.5%	#8

Table 1: Disney Attractions Ranking, Themed Entertainment Association Theme Index Report, 2016

The themed entertainment industry has experienced a twenty-two percent growth over the last ten years despite the global recession in 2008-2009 (TEA, 2015, 23). New brands and intellectual property within the themed entertainment industry such as Harry Potter, Avatar, and Star Wars are creating an increased attendance to parks such as Universal Studios (TEA, 2015, 23). The increased brand representation within the parks is drawing more significant traffic to Disney attractions internationally.

Disney's presence worldwide is profound. Two parks within the United States ranked number one and two for the highest attendance for theme parks worldwide in 2015. While Disneyland in Anaheim, California, hosts 17,943,000 guests in 2016 (TEA, 2016, 10), Disney World's 54 million visitors speaks volumes for its unique offerings for its guests. Disney World's resort model has created an integrated overall experience for guests. As guests remain within Disney's territory, Disney's brand is continuously featured within the overall system and guest experience (TEA, 2015, 26). With Disney's prominent presence in Orlando, Florida, visitation to the city has reportedly more than doubled over the past twenty years to 66.1 million visitors in 2015 (TEA, 2015, 25). Disney World's success has generated significant capital to create economic growth in Orlando, and the positive socioeconomic impacts will continue to benefit the surrounding area.

For the purpose of this project and the simulation, I have chosen to specifically focus on Disney World's Magic Kingdom. While Disney parks around the world have many positive attributes, the unique features and attractions available at Disney World compliment my project's mission. The forty-three square miles park and four theme parks within Disney World's territory, Magic Kingdom, Epcot, Hollywood Studios, and Animal Kingdom, provides guests with a wide variety of parks and attractions to visit and participate in (Dayao, 2014). In addition to the four

parks, there are over two dozen hotels within Disney World that park guests can stay in during their magical stay (Dayao, 2014). There is a comprehensive transportation system within Disney World which provides complimentary buses, trains, or boats to parks from on-site hotels or between parks (Dayao, 2014). The most notable feature of Disney World, which compliments this project's objectives, is the enhanced technology integrated throughout the park, My Disney Experience and the MyMagic+ band, which will be discussed in subsequent sections.

Disney's Current Technology

Disney is capitalizing on the revolutionizing shift of advancing technology. Specifically, Disney's mobile application, My Disney Experience and their MyMagic+ band, integrate technology to ease their guest-park experience. Barnes (2013) has suggested that the happier guests are throughout their experience, the more time and money they will spend at Disney (Barnes, 2013, 1). The \$1 billion MyMagic+ band gives guests a very personalized experience (Kuang, 2015). Disney's personalized vacation management system helps make the park more accessible and amenable to modern consumer behaviour (Barnes, 2013, 1). The band uses RFID technology that connects Disney guests to various aspects of the park including their entrance tickets, dinner reservations, hotel room keys, FastPass access, and more (Barnes, 2013, 2). All guests' movements, purchases, and ride participation are tracked in order to create the most personal experience for the user (Barnes, 2013, 1). It also gives Disney an opportunity to create customized and refined marketing ads and materials for guests (Barnes, 2013, 1).

While the MyMagic+ band operates as the front end tangible product for guests, the My Disney Experience app keeps guests informed with park updates and provides a visual presentation of various pieces of information. The app updates guests on attraction wait times, provides attraction show times, includes park map, as well gives them the ability to manage

tickets and vacation details (Disney, 2017). An app, particularly the My Disney Experience app, is an excellent example of enhancing guest engagement, interaction, and experience. The interconnected technology of these two devices are creating more efficient and streamlined experiences for Disney guests. This technology evolves passive experiences into active and interactive experiences (Barnes, 2013, 3). While this type of technology has proven successful so far within Disney World in Florida, Disney is still looking for ways to improve their guest's overall experience as well as solve various problems continuously impacting their park, such as crowding.

Rolling out this type of technology has significant logistical challenges (Barnes, 2013, 3). As technology is always changing in this fast paced market, keeping the technology up to date poses a difficult and time consuming challenge. Moreover, Disney has to refine and improve their overall infrastructure to accommodate such technology (Barnes, 2013, 3). Significant training for Disney's 60,000 employees is a necessity in order to educate the millions of guests that enter Disney World in Florida each year (Barnes, 2013, 3). While this technology may not be for all guests, it has the potential to dramatically set Disney apart from its competitors and manage crowds and guest needs more effectively (Barnes, 2013, 3).

Method

Simulation Overview

Building on the current studies and research being compiled to investigate crowd behaviour and crowd mitigation, this project's simulation looks further into this issue, particularly for Disney World's Magic Kingdom. As mentioned previously, this project aims at investigating effective crowd mitigation techniques using a mobile application to influence crowd behaviour. In order to test the effectiveness of this theory, a simulation was necessary to visualize and analyze the level of influence objects and features would have on an individual's behaviour. For this simulation, I am specifically looking at a guest's overall pedestrian behaviour during their visit to Disney World's Magic Kingdom. To test this theory effectively, I used the AnyLogic Simulation system in partnership with Dr. Asgary and ADERSIM from York University. ADERSIM is the Advanced Disaster, Emergency and Rapid-Response Simulation (ADERSIM) which develops technologies and tools for simulating major disaster and emergency management (DEM) planning and operational functions such as disaster mitigation and prevention, emergency exercises, and more (York University, 2017).

A tool that ADERSIM and Dr. Asgary use to develop crowding and a DEM plan is AnyLogic. The AnyLogic Simulation model is a dynamic system that "enable analysts, engineers, and managers to gain deeper insight and optimize complex systems and processes" (AnyLogic, 2017). There are multi-method models that can be utilized in order to successfully simulate your desired project and objective. Combining the current research surrounding crowd mitigation as well as new theories and concepts proposed in this project, the AnyLogic tool captured the project's overall objectives and outcomes.

The simulation component for this project was necessary to capture raw data and identify trends in relation to the crowd mitigation theory proposed earlier in this paper. As the Magic Kingdom welcomes more than twenty million people per year, which equals out to be more than fifty-five thousand people per day, optimizing crowd levels is vital not only for the park's overall efficiency but the guest's overall experience. Disney is very protective of their company's data, such as park attendance, entrance rates, and guest demographics. As a result of the restricted availability of this information, numerous reputable sources such as the Themed Entertainment Association's (TEA) Annual Theme Index Report and TouringPlans.com provide credible estimates on Disney's data and statistics for businesses and consumers. The simulation was programmed using reliable park data from the TEA's Theme Index Report (2016) and TouringPlans.com to accurately replicate an average day within Disney's Magic Kingdom. The model was also programmed to answer the following objectives and questions: Is pedestrian traffic influenced by a prop placement? Is the traffic influence significant enough to act as an effective crowd mitigation tool? Are there certain areas of the park which draw more significant crowds and which area is best to influence crowd movement to? Finally, can we effectively and efficiently place props to directly influence crowd behaviour? With these objectives in mind, the simulation was designed with multiple features including entrance data, attraction duration and wait times, day itineraries for guests, and the Magic Kingdom map. These implemented features provided the simulation with real time data and information to produce accurate findings for analysis.

Using a satellite image of the Magic Kingdom, the park map was developed to properly reflect the park as well as fit the simulation requirements. After finishing designing the Magic Kingdom base model map for the AnyLogic Simulation system, which captured pedestrian

pathways, buildings, and attractions throughout the park, attraction duration and wait times were programmed. Numerous sources were researched and consulted to compile the most accurate data for the simulation. As mentioned previously, the attendance data was obtained through the estimates provided by the TEA's Theme Index Report (2016). Disney's website provided attraction duration times (Disney, 2017) and the attraction wait times were gathered on crowd sourced websites such as TouringPlans.com. These websites use crowd sourced information to provide real time data for wait times and crowd levels for their customers in various theme parks around the world. With a paid subscription to TouringPlans.com, customers have full access to crowd levels and wait times at all attractions at Disney World and Disneyland. Since the Magic Kingdom was the chosen park for this project's simulation, as mentioned previously, the Magic Kingdom's attraction wait times and duration were the focal point for research.

While the average wait times are important to understanding crowd levels within the Magic Kingdom, these wait times are dependent on how busy the park is. As attraction wait times are continuously changing as a result of the time of day and number of people at the attraction, having the simulation accommodate the fluctuation in wait times was significant for this project. In order to incorporate these variations, calculating the capacity per individual ride as well as the number of units within the ride was vital to create accurate and realistic wait times for each attraction. For example, the rider capacity per 'log' at Splash Mountain is eight people. Splash Mountain has approximately forty-five logs in circulation during the ride's operation. Thus, at one time the ride can accommodate approximately three hundred and sixty people (MousePlanet, 2017). In comparison, Aladdin's Magic Carpets can accommodate sixty-four guests on the ride's carpets each cycle for the attraction (MousePlanet, 2017). Establishing these capacities is important to determine the estimated wait times depending on the number of people

within the queue at the attraction. Using this information, the simulation was able to adjust the overall wait time for the guest. Therefore, guests will go through the attraction queues faster on quieter days at the park whereas the wait times will be longer during busier days. This feature made the simulation far more realistic and accurate in order to replicate real life scenarios at Disney. See Appendix A for a full list of attraction duration, wait times, and ride capacities used in the simulation.

In addition to wait times and crowd levels, TouringPlans customers also have full access to customizable itineraries for all ages so guests can plan out their visit to their desired Disney park. The itineraries capture rides and attractions suitable for each age group. Utilizing these itineraries for the simulation was significant as it captured diverse age groups who would use preset programs for their visit. As particular rides and attractions appeal to particular age groups, these itineraries were useful in identifying common themes for Disney guests during their visit to the park. Moreover for simulation purposes, it was useful to have a baseline control group who did not follow a preset itinerary in order to compare statistics and data to those who used a customized itinerary. Measuring the level of influence on crowd behaviour for individuals and groups with or without day itineraries is significant for the overall findings in this study.

Along with attraction wait times, crowd levels, and guest itineraries, the characters within the Magic Kingdom play a significant role in the simulation process. Characters are a prominent attraction within the park as guests of all ages enjoy interacting with characters (Disney, 2017). It is important to note that for the purpose of this simulation, characters will be dropped inside and outside their specific lands within the park. For some characters in particular, they are restricted to given lands within the Magic Kingdom to stay consistent with the land's overall theme. For example, Aladdin and Jasmine will typically remain in Adventureland as their Aladdin's Magic

Carpets ride is located within Adventureland (Disney, 2017). Moreover, Buzzlightyear will typically stay within Tomorrowland's boundaries as his futuristic character and ride is located within Tomorrowland (Disney, 2017). Each day, Disney's characters hold various meet and greets and performances for the park's guests (Disney, 2017). In the real life implementation of this simulation, these character placements would be in addition to the scheduled character meet and greets. Despite characters typically remaining in their given lands to stay consistent with the brand and theme, for the purpose of this simulation, the character attractor drops were dependent on the crowd levels within the park and were placed within random, less crowded areas of the park to test this project's interactive crowd mitigation theory.

The goal of the simulation was to test the effectiveness of the crowd mitigation theory through this simulation. The most accurate data, including attraction wait times and Disney character information, was used to simulate an average day in the Magic Kingdom for Disney guests. By using reputable sources within the industry, the integrity of the overall design of the simulation was maintained. The following section of this paper will analyze how the simulation was run, the research method, as well as the findings from the simulation.

Running the Simulation

Following the completion of the AnyLogic simulation model, the simulation was ready to be run and analyzed. As there are numerous characteristics involved with this particular simulation such as daily park visitor numbers, attraction duration and wait times, and attractions throughout the park, calibration was required to properly engage and capture the various features. Calibration was useful to identify any potential problems with the pathways and character interactions within the simulation. Following calibration, the first simulation was run. At the beginning of each simulation, particular settings were able to be adjusted to create

different environments for the Magic Kingdom. Features such as arrival rates and itinerary settings were adjusted to represent quieter or busier days within the park.

Throughout the simulation, guests' behaviour was constantly influenced by character attractor placement on the Magic Kingdom simulation map. The simulation uses a heat map to represent the concentrated areas of people in the park. This is significant as it helps illustrate which areas of the park are overcrowded and which areas could help ease crowding issues by influencing pedestrian movement to less crowded areas of the park. Using the heat map, the character attractor was placed outside busy areas of the park to encourage movement towards less crowded areas. By using characters to drive crowd movement throughout the Magic Kingdom within the simulation, this particular crowd mitigation tool was tested.

Results

The results of the simulation confirm that the character attractors influenced approximately 30% of crowd behaviour and successfully acted as a crowd mitigation tool. Throughout the simulation, notable crowd behaviour movements were observed. As seen in the graph below, crowd behaviour is directly correlated with the character movement. The Disney character was placed in Frontierland in the simulation. After approximately two hours, the character was moved to Fantasyland. The graph depicts a decline in guest attendance within Frontierland attractions such as Jungle Cruise. Furthermore, it also illustrates an increase in attraction attendance within Fantasyland at attractions such as Under the Sea: Journey of the Little Mermaid.

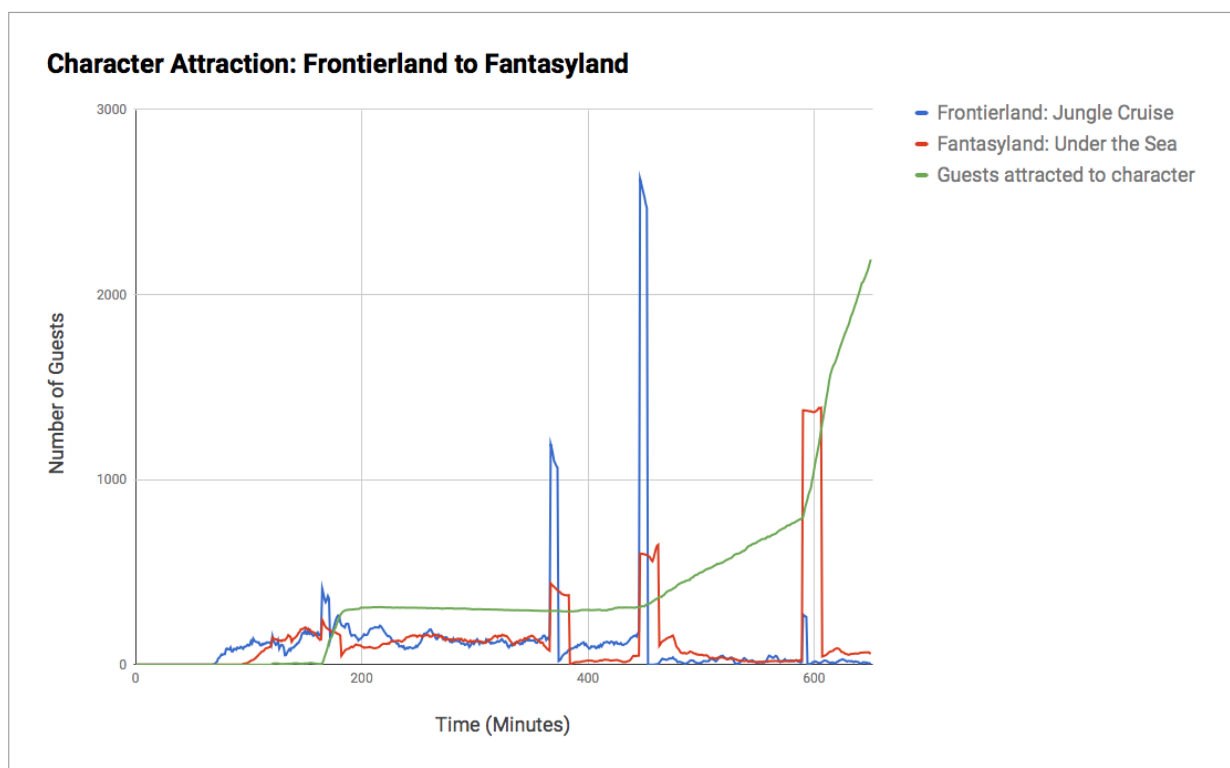


Figure 1: Simulation Data Graph

With almost 30% of the Magic Kingdom guests being influenced by character movement during their visit, Disney can utilize these findings to proactively move guests and mitigate crowds throughout the Magic Kingdom.

During the simulation, particular lands in the park were more successful at attracting guests. When the Disney character was placed in Frontierland and Fantasyland, these two lands had the most impact on crowd migration in relation to the character attractor's location. Many particular reasons can explain the significant increase in attraction for those given areas. As Fantasyland has the most rides and attractions, more guests gravitate towards Fantasyland in the park. In addition, Frontierland is home to many popular attractions such as Big Thunder Mountain Railroad and Splash Mountain.

Location	Cinderella's Castle	Tomorrowland	Fantasyland	Frontierland
Number of guests attracted to character	430	596	2360	3180

Table 2: Simulation data for Disney character guest interaction

Using the data attained through the simulation, Disney can experiment on how to influence and mitigate crowds with these given areas. Moreover, further research is necessary to investigate how the other lands can increase their level of attraction for Disney characters and guests.

Simulation Discussion

The AnyLogic Simulation system has been helpful in identifying how successful the proposed crowd mitigation tool is. With the results attained throughout the simulation project, positive trends have been identified which can be used to mitigate crowds throughout the Magic Kingdom. However, there are a few limitations to note which will be the focus of future work in this area of research. To begin, the simulation was programmed with guests fulfilling outlined itineraries for their daily visit. It did not take into account guests that come into the Magic Kingdom with no plan or itinerary and who just plan their day as they go. This difference between guests with and without itineraries could further impact the level of influence Disney characters have on crowd behaviour.

Another possible limitation of the simulation is that it does not take into account fluctuations in crowd levels in the park each day. As mentioned previously, the simulation is pre-programmed with entrance rates, itineraries, and attraction wait times and duration length. As a result of the pre-programmed nature of the program, the simulation does not reflect weather changes, special events, or varying levels of crowds. While the intention was to run low, medium, and high seasons for the simulation, due to bandwidth constraints within the program, only low season schedules were able to run on the simulation system. Therefore, more research is required to measure the level of influence on crowd behaviour in busier times of the year.

The final limitation within the simulation program is the lack of demographic information programmed for the pedestrians. For the purpose of the simulation, Mickey Mouse was used as the sole Disney character. Since different types of Disney characters attract different people with diverse demographic information, demographic information would have to be taken into account to create a more realistic environment in relation to Disney characters. Although demographic

information is difficult to attain for Disney guests, surveys for Disney guests would be necessary to gather accurate information to further improve this project.

Future Work

Future work and adjustments are necessary to continue to advance this research project and create a more realistic Disney Magic Kingdom environment. In particular, programming different characters with demographic information, in addition to Mickey Mouse, is important as there are thirty-seven additional characters within the park. Moreover, adjustments to itineraries will be required to create a more fluid environment within the simulation. Although the current simulation model is accurate with entrance rates and attraction wait times, these adjustments will create a more realistic research simulation.

Implementing this crowd mitigation tool and simulation structure within the Magic Kingdom is also a prominent element of future work to test the theory in real life application. A live simulation in the park will create real time data to see how guests interact with Disney characters and how crowd behaviour is influenced. Moreover, we will be able to witness the impacts of crowds within Magic Kingdom's lands as well as the realistic uptake on the proposed mobile app. Field testing and further research would be necessary and will be completed to investigate the level of uptake and reception of the proposed mobile app and crowd mitigation theory. This is vital to test the true effectiveness of this idea in the themed entertainment industry for theme and amusement parks, local fairs and festivals, as well as major sporting events. While the simulation revealed that Frontierland and Fantasyland significantly attracted crowds, a real life application of the simulation may reveal other positive trends in relation to this crowd mitigation tool. Using this simulation in an everyday setting in the Magic Kingdom will outline and depict how this crowd mitigation tool can be utilized and implemented.

Product Design

Proposed Mobile Application: Disney2Go

Ideas are constantly being presented to Disney in order to maintain Disney's unique competitive edge as well as stay current with the latest technology. The proposed idea, Disney2Go, will integrate augmented reality (AR) and GPS technology within a mobile app. Perhaps future application and discussion can integrate Disney2Go within Disney's pre-existing *My Disney Experience* mobile application. The goal of the application is to improve the guests' overall experience at Disney parks. There is a wide target audience for the mobile app as guests of all ages are welcome to use it to increase their level of engagement within the park. AR technology, Disney2Go will allow guests to find and keep track of their favourite Disney characters. This will ultimately eliminate any user frustrations in tracking down characters throughout the park.

Guests of all ages and demographics will use the app to search for Disney characters in proximity to their location, in real time. For example, if a guest wants to search for Mickey Mouse, they would use the interactive Disney park map to find Mickey's location. The application will use GPS satellite coordinates to determine the guest's location, generating real-time directions to the character. Guests can also opt in to receive push notifications for when a guest is in proximity to their location.

The application presents benefits to the park ergonomics and traffic flow. Parks can use the application to control crowds in particularly busy areas of the park. Rearranging the popular characters throughout the park will enhance the overall safety and efficiency of the crowded park. Disney2Go's interactive and engaging user-experience is predicted to increase the guest-user experience.

Disney2Go Technological Components

AR technology is becoming more popular in society. The uniqueness of the technology provides a new way of looking at an individual's surrounding environment. With new and innovative technology, Disney is able to revolutionize and adapt their current infrastructure. The mobile app that we are proposing is one avenue for Disney to improve their overall technological infrastructure within the park. In addition, the app looks to improve the guest's overall experience as well as the park's efficiency, show and safety. There are several necessary components within the app. Components ranging from the AR technology, GPS location tracker technology, Disney park map, park features and characters, and app user experience.

Augmented Reality and Pokémon GO

AR technology has been on the rise over the last few years in several industries. AR has received particular attention over the last year as a result of Pokémon GO. As this project and the app was inspired by Pokémon GO, analyzing and understanding the functionalities of Pokémon GO is vital. However, understanding how Pokémon GO has influenced the movement of people across various communities is significant and vital for this project (Colley, 2017, 1). Pokémon GO is a free to play, location-based game that uses fixed locations, called PokéStops, to receive various benefits at each location (Colley, 2017, 3). Locations around various communities are crowd sourced historical markers, churches, parks, monuments, pieces of art, and more (Colley, 2017, 3). The PokéStops create incentive-based movements for users as they search for various Pokémon and receive game bonuses (Colley, 2017, 3). The more crowd sourced locations for PokéStops throughout communities, the more bonuses available for players. PokéStops incentivized individuals to move throughout a community to receive various bonuses. 60% of Pokémon GO players visited one new place at least once and 17% of individuals said they went

to several new places as a result of the game (Colley, 2017, 8). It is also important to note that the game influences where people spend money. For example, 46% of users spent money while using the game and 50% of purchases were made on food and drinks (Colley, 2017, 8). This is significant as it reflects that bonuses at various locations can positively impact consumer spending and income for local businesses. As Pokémon GO has arguably proven incentive-based movements to be successful, this concept can be applied and implemented in other industries for various events.

Many scholars and business owners are questioning whether the success of Pokémon GO can be replicated in other industries (Atanda, 2016). As technology is continuously changing, innovation in the technology field is vital. As Pokémon GO was free to play with in-app purchases available, it is accessible for any individual with a mobile device (Atanda, 2016). There are three notable aspects of the game that make it so appealing for users. The first is the simplicity of the game. As the objective is consistent and straightforward no matter what part of the app you are in, the mandate stays the same. This improves accessibility for all users ranging from casual gamers to avid Pokémon fans (Atanda, 2016). The second element is the nostalgia aspect of the game. Since Pokémon was a huge phenomenon during many people's childhoods, the classic game allows players to reminisce on memories (Atanda, 2016). The final and most notable element is the social aspect of the game. As the app is most commonly used in groups, you are able to meet people and stay active (Atanda, 2016). The traditional video game involves players sitting in front of a screen. Pokémon GO allows individuals to get out of their house, get active, and meet people along their way. These three aspects of Pokémon GO make the game very appealing for users. Moreover, companies and tech entrepreneurs should utilize the simplicity and social aspect of the game in order to create and develop, hopefully, another

successful mobile game or app.

Disney2Go aims to replicate the successes of Pokémon GO for its users. Currently, Pokémon GO has registered three utility protected patents directly related to location based gaming. Further research and investigations with patent lawyers will need to be conducted in order to differentiate Disney2Go from Pokémon GO. As mentioned previously, the new and innovative aspect of AR has captivated users across the world. Integrating mixed reality and fantasy, where strong doses of physical reality and virtual elements are combined, develops an avenue for imagination for an individual (Stapleton et al., 2002, 122). This avenue fosters a person's imagination as people desire to believe (Stapleton et al., 2002, 123). Furthermore, creating an enhanced viewpoint in one's physical world allows theme parks to bend the audience's perception of reality. Creative methods and models that are employed within theme parks depend on what is in-demand or on-trend (Stapleton et al., 2002, 124). Thus, as a result of the rise in AR, theme parks can capitalize on this up and coming trend and integrate such technology into their parks. As Disney is continuously revitalizing their technology for rides and attractions, implementing AR can introduce a new captivating element for guests in the theme park.

Disney2Go will use the latest technological advancements in the AR field and apply them to the app. The AR aspect of the app would be utilized to project the desired Disney character onto the guest's screen. In an attempt to move crowds throughout the park as a result of overcrowding in particular areas, guests would search for their favourite Disney characters and look for their location. The character would appear on the guest's screen in an AR type format and the character would direct the guest to their location in the park, using GPS technology which will be discussed in the subsequent section. This form of directional signals, using the AR

technology, will be a unique way of implementing crowd mitigation techniques throughout the Disney theme park.

GPS Technology and Location Trackers

GPS technology is required in order to make this app completely functional. The guest would use the app and the integrated GPS technology to track Disney characters throughout the park. GPS technology has continued to advance and increase its capacity over the last thirty years (Tomkiewicz et al., 2010, 2163). As a result of this technological evolution, more opportunities are created for the technology. We are seeing a rise in household gadgets with GPS functionalities. Through utilizing the technology, one can gain a better understanding of its capabilities (Tomkiewicz et al., 2010, 2163). Utilizing this information, we are able to adapt and implement the current technology into more gadgets and platforms. This type of technology will be necessary to make Disney2Go operational.

The first component of the GPS technology would be to track the Disney characters and their given location in the park. Tracking the characters via GPS technology is significant as it will give the most accurate information possible to the guest at where their favourite Disney characters are located. The GPS technology would be embedded within the character's costume to give an accurate location. The second component of the GPS technology would be utilized by the guest's mobile device. Standard smartphone devices in today's society are GPS enabled. Using the guest's GPS capability within their smartphone, the app can use the guest's location in relation to where the character is. After the app has recognized the guest's location as well as the character's location, the app will then direct the guest in the direction of the character. As mentioned previously, the augmented projection of a Disney character would guide the guest on their mobile device screen. The GPS technology will create an effective and efficient way for

guests to find Disney characters throughout the park.

The final and most attractive component of the app, in Disney's eyes, is the crowd mitigation opportunity within the app. As there is two-way GPS technology between the guest and the character, Disney is able to monitor the phone traffic and GPS pings in particular areas of the park to measure and identify which areas of the park are crowded. As a result of this information, Disney would be able to place characters in other less crowded areas of the park to encourage people to move to those given areas, thus reducing the burden on particular areas of the park. Therefore, Disney can use the two-way GPS technology as a crowd mitigation technique. This is significant as Disney is not only able to improve the show aspect of the park, they are also improving the safety and efficiency elements of the park. As the park becomes more efficient and less crowded in particular areas as a result of Disney2Go, the efficiency element of the park is enhanced. More importantly, the safety aspect of the park is increased to reduce overcrowding.

Augmented Reality User Experience

As AR gains significant traction in modern theme parks, the frustrations and complications are unknown. Limited research has been studied on user satisfaction of AR being utilized in theme parks. Chung, Jung, and Leue (2015) have determined the main contributing factors for a positive AR experience. By understanding the importance of personalized service, content quality and system quality, Disney is able to apply these similar notions to their My Disney Experience application. Currently, the application features several personalization features, such as viewing photos, scheduling plans and buying passes. There is possibility for further advancements to the Disney's application, which includes recommending characters to guests based off user-preference and settings.

Von der Putten et al. (2012) has determined that AR presents valuable benefits for the tourism industry (Jung, Chung & Leue, 2015). Implementing an interactive online environment allows tourists to experience destinations in real-time. A study conducted by Mascioni (2012) also draws reference to theme parks that have already integrated on-site AR within their indoor attraction rides (Jung, Chung & Leue, 2015). Theme parks, such as Disney have recognized the possibility of expansion into the AR industry. Disney should be looking into such technology and exploring how AR can enhance their guests' experiences.

Augmented Reality User-Testing in Theme Park

Advancements in technology have enabled AR to be implemented into mobile applications. This has enhanced the overall consumer-mobile experience. Chung, Jung, and Leue (2015) investigate user satisfaction of AR applications in the tourism industry. It was hypothesized that personalized service, content and system quality will have a positive effect on AR satisfaction. To test this hypothesis, a questionnaire was administered to 241 visitors at Characworld theme park located on Jeju Island, South Korea. Respondents were asked to use Characworld's existing AR applications to engage in virtual horseracing, video and computer games. The application had virtual characters superimposed and overlaid into the real environment.

Using pre-existing literature, Chung, Jung, and Leue (2015) determined six main constructs that were researched in the present study: content quality, system quality, personalized service quality, satisfaction, intention to recommend and personal innovativeness. A study conducted by Lee et al. (2014) has determined that users perceive content quality as an important attribute for mobile tour guides (Jung, Chung & Leue, 2015). Based off this research, the present study was able to measure the impact of high-quality context on an individual's intention to

recommend an AR application. The next construct Chung, Jung and Leue investigated was personalized service quality. DeLone and Mclean (2003) suggest that the most important attributes of an AR application is personalized interaction (Jung, Chung & Leue, 2015). This specifically refers to the user's ability to personalize the application according to their preferences. Research has indicated that personalized service has increased user value and satisfaction (Jung, Chung & Leue, 2015).

The goal of the study was to determine the relationship with tourist satisfaction on the overall quality of AR applications. Chung, Jung, and Leue (2015) concluded that all three constructs (content quality, system quality and personalized service quality) have positively impacted tourist satisfaction with AR applications. It was determined that system quality had the least significant effect on the tourists' behavioural intentions to recommend AR applications. The study further explored the respondent's thoughts on personal innovativeness and whether there is a correlation between low innovativeness and high innovativeness on a user's satisfaction. Respondents that indicated a preference for high innovativeness suggested they prefer visually appealing and user-friendly mobile applications, whereas those respondents who preferred less innovation wanted easy to read, relevant information.

Applications that have integrated AR, such as Pokémon Go, have received particularly positive feedback from users. It is important to note that these applications do require in-depth and intense user testing. Without understanding the user frustrations and gaining feedback, it is nearly impossible to make amendments to these applications in order to better suit customer needs and wants. Chung, Jung, and Leue (2015) have determined that tourists value personalized mobile interactions.

Augmented Reality and User Interface

When designing a mobile AR application, the most important attribute to consider is the context that the application will be used (Ganapathy, 2016). In this case, the Disney2Go application will be utilized as a navigation assistant tool. Understanding this context is important for the design considerations, as there is a variety of information that must be augmented. This includes ride attractions, points of interest, characters, restaurants and buildings (Ganapathy, 2016). The mobile phones will allow the users to view the environment in real time with computer-generated graphics overlaid on the points of interest. Several design guidelines have been identified to determine how the application will be designed in order to maximize the user-application experience. The categorizations include graphic user interfaces, AR markers and the user's physical and digital intuitive interactions.

The Disney2Go application will utilize marker-less based tracking. This technology integrates the mobile phone's camera to detect and track the user's environment- in real time. Virtual objects and images are superimposed onto the screen and aligned to match the user's camera "markers" (Swedlund, & Ortman, n.d.). A marker can be defined as an image reference point from the augmented and physical world (Swedlund, & Ortman, n.d.). Specifically, marker-less based applications use the mobile phone's GPS capabilities to locate and interact with the augmented-reality technology. Typically, marker-less based applications are more complex to code since they will need to calculate the pose matrix (rotation and translation) of detected images. Using the iPhone or Android's dual core processors, Disney2Go will use natural tracking technology to make sense of the guests' location. In addition, marker-less based applications use sensors to detect the real-world environment (Swedlund, & Ortman, n.d.). In this case, the Disney2Go application will detect the shops, attractions, points of interest and

characters to superimpose computer-generated images over the real-world environment. The application will use the AR features to superimpose the character's location and images onto the user's screens.

Graphic User Interfaces (GUI)

The graphical user interface of the application is the design elements that the users interact with such as buttons, icons and any other interactive images (Swedlund, & Ortman, n.d.). GUIs will be placed on top of physical objects, enhancing the park through augmentation. The application developer will assign specific virtual hotspots to each Disney character. These coordinates will be augmented as interaction hotspots (Swedlund, & Ortman, n.d.). When the user's camera scans over these hotspots it will trigger character proximity notifications. Like all technology, there is possibility that the iPhone/Android will have technical difficulties. In this instance, the user may have difficulties pointing their camera towards the points of interest, resulting in no augmented images appearing (Swedlund, & Ortman, n.d.). To mitigate these technical concerns, the application will have guided lines on the camera viewpoint, showing the user exactly where to point. Moreover, AR that requires the use of cameras is difficult to engineer. These types of applications have difficulties of continually tracking the user's cameras and location, making the velocity sensors and accelerometers overwhelmed (Greenemeier, 2009). Integrating inertia sensors will allow for a better measure of an accurate and absolute position of the Disney characters (Greenemeier, 2009).

The featured component, Disney2Go will follow similar design principles as any mobile application. Disney2Go will be modeled after the My Disney Experience, containing similar buttons, gestures and icons. This similarity will make the user experience more unified, eliminating any pre-eminent user-experience concerns. Each of the characters will need to go

through a detailed design process, so that their characters are accurately depicted on the user screen. This includes working with graphic designers to engineer a 360-degree computer-generated image of each character, which can be a time consuming and expensive process.

User Interactions

Disney2Go will enable the user to control their own surroundings of both the virtual and physical environment. This allows the guests to scroll through the park maps, and browse the area using a 360 degree augmented world. Designing for user interactions requires an in-depth analysis of the user's control and application usage. It is important to keep in mind that mobile applications are generally designed for one-hand interactions. As a result, the application will need to be designed for single handed scrolling and one handed gestures, such as zooming on the map or double tapping on a character's location.

The application must have clear guidelines for how the user will interact with the augmented space. The first time the application loads, a virtual tour guide (Minnie Mouse) will appear and walk the user through the instructions. This helps the user navigate the space and understand the limitations that the app may have. In-app tutorials provide the user with an introductory tutorial with screenshots and easy-to-read instructions.

When designing mobile AR applications, there are some limitations that may inhibit the design. The most notable limitation is the technology's ability to track and register the characters. The application may have some difficulties with the accuracy and constant connectivity (Swedlund, & Ortman, n.d.). Keeping this constraint in mind, the design will clearly denote when the application is tracking or when it has lost tracking signals. Certain restrictions may inhibit the signal from tracking the characters, such as out of boundaries or indoor tracking. The application will notify the user that they have lost tracking capability.

Product Discussion

Future Application of the Crowd Mitigation Tool

This proposed crowd mitigation tool can be applied to numerous events and scenarios in the future. Ranging from other theme and amusement parks around the world, major sporting events, and emergency crisis management, this tool is versatile in application. As mobile devices are becoming increasingly common among people of all ages, its capabilities can engage users as well as assist businesses in interacting with customers and guests. In particular, businesses can utilize cell phone traffic and GPS location capabilities to control crowds in a given area. The versatile application of the crowd mitigation tool can change the way crowds behave and operate.

Similar to Disney's Magic Kingdom, other theme and amusement parks from around the world can use this technology and this tool to mitigate crowds. As millions of people travel to theme and amusement parks, reducing crowds and wait times will improve park efficiency and overall guest satisfaction. While each park has their own brand and overall theme, the mobile app would be adjusted to reflect their unique brand.

As this research project was completed in partnership with ADERSIM, emergency crisis management was a significant focus of the simulation. Effectively controlling crowds is vital to ensuring safety and managing emergencies and crises. As our society continues to develop plans and systems in response to growing violence and threats, creating effective exit routes in the event of an emergency is essential. Moreover, simulation programs such as AnyLogic can identify how pedestrians will react to varying route changes, obstructions, and other potential influences to their overall crowd behaviour. Simulating emergencies, crises, and other events will enhance the understanding of crowd behaviour.

Major sporting events are another platform where this proposed mobile crowd mitigation tool can be implemented. While single sporting events can use the tool to interact with guests while effectively influencing crowd behaviour, this app would work best for tournaments and multi-sport events such as the Olympics. These wide scale events attract significant crowds at various locations. This app would be utilized to engage guests and send important information to their mobile devices. Furthermore, it would track individual's locations and direct them to other attractions and events to reduce crowding in particular areas. London's 2012 Olympic Village is a great example on how guests and the Olympic organizers can utilize this crowd mitigation app. Millions of people visited the numerous attractions within Olympic Village over the two week Olympic games in 2012 (Oliver, O'Mahony & Palmer, 2012). Guests can use the app to find events and attractions they are searching for while event organizers can use the app to track and manage crowds within the village. Creating an interactive environment digitally as well as in reality is vital to engaging a diverse range of visitors while maintaining safe crowd levels.

Festivals and local fairs can also utilize this tool to migrate crowds throughout their venue. The unique multifaceted environment of festivals and local fairs offers a great opportunity for this app to be utilized. Similar to the previous examples, the app will engage guests digitally as they search for particular attractions, musical acts, food vendors, or celebrities. Meanwhile, the event organizers can move mobile vendors and meet and greets to accommodate crowd levels throughout the venue.

Combining the simulation program as well as the proposed mobile application, businesses can apply this system to their unique infrastructure or event. The diverse and versatile application of this tool gives individuals and businesses a unique opportunity to simultaneously create digital engagement while successfully moving crowds within a particular area or venue.

Conclusion

Disney2Go has the ability to change the face of the themed entertainment industry by providing a solution to overcrowded theme parks with a tech based tool. The integrated augmented reality and GPS technology within the app provides an interactive platform for Disney guests while attempting to improve their overall experience in a popular and crowded theme park. Disney is continuously improving their infrastructure and park attractions for their guests and Disney focuses its changes and improvements using the Disney *four keys*: show, efficiency, courtesy, and safety. The objectives of Disney2Go compliment Disney's *four keys*. As the app has the capability of reducing overcrowding in various areas, this will allow all four keys to be enhanced, particularly the safety and efficiency keys. Crowd mitigation will improve safety by dispersing crowds of people throughout various sections of the theme park. In addition, the park will become more efficient by reducing wait times for rides, attractions, and Disney characters. The simulation proved that the proposed app and Disney characters can influence approximately 30% of park. This data supports the view that Disney2Go will act as an effective crowd mitigation tool and can strategically influence crowd migration throughout the Magic Kingdom.

While the app can act as Disney's primary crowd mitigation tool, it also will engage guests and improve their overall experience is Disney's primary objective. As the Disney characters draw a significant crowd to the parks each year, they represent a vital component to the park's success. The app will increase engagement between the characters and the guests by leading guests effectively to the character's location. As Walt Disney said, "Disney will never be completed. It will continue to grow as long as there is imagination left in the world." The magic and fantasy elements of Disney will continuously evolve as technology advances and

imaginations soar. Disney2Go upholds and respects Disney's main objectives and keys through its innovation, attention to detail, and focus on Disney's park safety, efficiency, and overall guest experience.

Appendix

Appendix A

Ride/Attraction Name	Wait Time	Duration	Total Time	Seats	Total capacity
A Pirate's Adventure - Treasure of the Seven Seas	---	15 Min	15 Min	---	---
Jungle Cruise	15 Min	8 Min	23 Min	30 x 8	240
Pirates of the Caribbean	35 Min	7.5 Min	42.5 Min	20 x 15	300
Swiss Family Treehouse	---	12.5 Min	12.5 Min	---	---
The Magic Carpets of Aladdin	10 Min	1.5 Min	11.5 Min	2 X 32	64
Enchanted Tiki Room	---	10 Min	10 Min	250	250
Big Thunder Mountain Railroad	45 Min	7 Min	52 Min	30 x 5	150
Country Bear Jamboree	10 Min	10 Min	20 Min	100	100
Frontierland Shootin' Arcade	---	3 Min	3 Min	---	---
Splash Mountain	60 Min	18 Min	78 Min	8 x 45	360
Tom Sawyer Island	---	30 Min	30 Min	25 x 3	75
Hall of Presidents	---	10 Min	10 Min	700	700
Haunted Mansion	50 Min	10 Min	60 Min	2 x 160	320
Liberty Square Riverboat	15 Min	16 Min	31 Min	300+	300
Casey Jr. Splash 'N' Soak Station	---	15 Min	15 Min	---	---
Dumbo the Flying Elephant	25 Min	1.5 Min	26.5 Min	2 X 16	32
Enchanted Tales with Belle	30 Min	20 Min	50 Min	48	48
It's a small world	15 Min	14 Min	29 Min	20 x 30	600
Mad Tea Party	10 Min	1.5 Min	11.5 Min	4 x 16	64
Many Adventures of Winnie the Pooh	35 Min	4 Min	39 Min	4 x 12	48
Mickey's PhilharMagic	10 Min	12 Min	22 Min	496	496
Peter Pan's Flight	65 Min	3 Min	68 Min	3 x 16	48
Prince Charming Regal Carrousel	10 Min	2 Min	12 Min	90	90

Seven Dwarfs Mine Train	70 Min	3 Min	73 Min	20 x 3	60
The Barnstormer	30 Min	2 Min	32 Min	16 x 2	32
Under the Sea ~ Journey of The Little Mermaid	25 Min	7 Min	32 Min	2	Unknown
Astro Orbiter	20 Min	1.5 Min	21.5 Min	2 X 16	32
Buzz Lightyear's Space Ranger Spin	30 Min	4.5 Min	34.5 Min	2	Unknown
Carousel of Progress	5 Min	21 Min	26 Min	240	240
Monsters, Inc. Laugh Floor	20 Min	15 Min	35 Min	460	460
Space Mountain	80 Min	10 Min	90 Min	12 x 13	156
Stitch's Great Escape!	10 Min	12 Min	22 Min	200	200
Tomorrowland Speedway	20 Min	4.25 Min	24.25 Min	2 x 140	280

Sources: Disney (2017) & TouringPlans.com (2017)

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